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PATENT APPLICATION

for

A VERTICAL BAG FORM-FILL-SEAL PACKAGING MACHINE

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A VERTICAL BAG FORM-FILL-SEAL PACKAGING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vertical bag form-fill-seal packaging machine, and more particularly to a vertical bag form-fill-seal packaging machine for forming bags by sealing a continuous tubular packaging material in which a product to be packaged is filled, and then separating and ejecting each of the bags.

2. Background Information

Vertical bag form-fill-seal packaging machines exist as packaging devices that fill a product to be packaged, such as food, into bags which are being formed at the same time. In a conventional vertical bag form-fill-seal packaging machine, a packaging material in a sheet-like film form is fed over a former and into a tube. The material is formed into a tubular shape that conforms to the vertically long tube through which it goes. The overlapped vertical ends of the tubular packaging material are then sealed (heat-sealed) by a vertical sealing mechanism. The product to be packaged, which is allowed to drop from a higher position, is filled into the tubular packaging material via the tube. Then, the portion of the tubular packaging material that will become the top of a bag and the bottom of its next bag is transversely sealed by a transverse sealing mechanism provided under the tube. Immediately after this, a cutter cuts the center of the transversely sealed portion. In such a

vertical bag form-fill-seal packaging machine, two types of operations, the forming of the bags and the filling of the product to be packaged into the bags, are carried out continuously as described above.

In such a conventional vertical bag form-fill-seal packaging machine, each of the bags separated from the following bag by the cutter falls freely onto a stationary chute provided below the transverse sealing mechanism, and is led to a belt conveyor in a downstream process. The stationary chute is similar to a playground slide made of a metal plate or the like, and plays the role of transferring the bag to the belt conveyor in the downstream process by taking advantage of gravity.

In a conventional vertical bag form-fill-seal packaging machine, the bags are allowed to fall freely using gravity before they are ejected onto the belt conveyer in the downstream process. With improvements in bag-forming capacity in recent years, however, the quantity of the bags ejected per unit of time has increased. With the traditional quantities of bags to be ejected, a small degree of variation in the bag ejection interval and posture would not lead to a problem on the belt conveyor or other devices in the downstream process. However, with the quantity of the bags to be ejected ever increasing, a problem with the devices could result in the downstream process. Particularly, with the increase in the quantity of the bags to be ejected, or the higher-speed operation of the vertical bag form-fill-

seal packaging machine, which causes the bags to be ejected at a shorter interval, a minor variation in the bag ejection intervals may lead to a problem with the devices in the downstream process. For example, two bags may be loaded instead of one on a weight checker or a seal checker in the downstream process, or the mishandling of the bags or the disorganization of the file or files of the bags may result at a boxing device. Such problems could stop the production line, thus lowering the line operation rate and preventing the achievement of high-speed operation.

In view of the above, there exists a need for a vertical bag form-fill-seal packaging machine which overcomes the above mentioned problems in the prior art. This invention addresses this need in the prior art as well as other needs, which will become apparent to those skilled in the art from this disclosure.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a vertical bag form-fill-seal packaging machine that prevents variation in the pitch and posture of the bags that are continuously ejected.

A vertical bag form-fill-seal packaging machine in accordance with a first aspect of the present invention provides a vertical bag form-fill-seal packaging machine for forming bags by sealing a continuous tubular packaging material in which a product to be packaged is filled, and then separating and ejecting each of the bags. The vertical bag form-fill-seal

packaging machine includes a first transfer unit, a first drive unit, and a control unit. The first transfer unit transfers the separated bags to another transfer unit or conveyor provided in a downstream process. The first drive unit drives the first transfer unit. The control unit controls the first drive unit to control the interval or the posture of the bags to be ejected after being transferred by the first transfer unit. In this case, the first transfer unit is provided instead of a conventional stationary chute. The bag interval and the posture of the bags to be ejected are maintained by controlling the first drive unit that drives the first transfer unit. Therefore, even during high-speed operation with an improved bag-forming capacity, the variation in the pitch and the posture of the bags can be reduced. With a conventional stationary chute, on which frictional resistance (as the bag slides) and an impact (as the bag comes off the chute) occurs, there is a high probability that the pitch and the posture of the bags may be adversely affected. By using the packaging machine as defined in the first aspect of the present invention, in which the first transfer unit is provided and the transfer of the bag on the first transfer unit is controlled, variations in the bag ejection pitch and posture are prevented.

A vertical bag form-fill-seal packaging machine in accordance with a second aspect of the present invention is the machine as defined in the first aspect, wherein the control unit provides control so that the bag ejection interval is larger than the bag separation interval.

The bags are prevented from being transferred to the conveyor or the transfer unit or other devices in the downstream process without a proper interval.

A vertical bag form-fill-seal packaging machine in accordance with a third aspect of the present invention is the machine as defined in either of the previous aspects, wherein the first transfer unit is a belt.

In this aspect, a relatively simple structure having a belt and a first drive unit for moving the belt, such as a motor, is used to restrict variation in the bag ejection pitch and posture. It is easy and inexpensive to incorporate this structure into a vertical bag form-fill-seal packaging machine of the present invention or during initial construction to retrofit it to a conventional vertical bag form-fill-seal packaging machine. To prevent variation in bag posture that may be caused by the drop impact, the belt is preferably set in a position so that it contacts the bags immediately after they are separated from the supply roll of packaging material.

A vertical bag form-fill-seal packaging machine in accordance with a fourth aspect of the present invention is the machine as defined in the third aspect, wherein the belt is inclined so that the bags move diagonally downward. In this case, with the belt inclined, the bags separated from the supply roll of the packing material surely contact the belt. The incline of the belt is such that it allows the bags to move diagonally downward, thereby

reducing the impact that may be caused on the bags upon their contact with the belt, thus reducing changes in bag posture. Additionally, preventing the bags from being transferred in a stand-up posture, the bag-to-bag interval is more constant. The incline of the belt further contributes to a reduction in the impact that may be caused when the bags move from the belt to the transfer unit or conveyor in the downstream process.

A vertical bag form-fill-seal packaging machine in accordance with a fifth aspect of the present invention is the machine as defined in the third or fourth aspect, wherein the first transfer unit includes two belts holding each of the bags in a sandwiched manner. In this case, the bags are transferred while being held by the two belts in a sandwiched manner. Thus, the bags are securely held, thereby reducing problematic variations in the bag ejection pitch that may be caused by the slippage of the bags and belt.

A vertical bag form-fill-seal packaging machine in accordance with a sixth aspect of the present invention is the machine as defined in the fifth aspect, wherein the first transfer unit is such that a part of a transfer passage formed between the two belts is inclined so that the direction of the bag transfer changes as the bag moves therethrough.

A vertical bag form-fill-seal packaging machine in accordance with a seventh aspect of the present invention is the machine as defined in the fifth or sixth aspect, further including a means for changing the distance between the two belts, wherein the control unit

controls the means for changing the distance between the two belts according to the bags, so as to adjust the distance between the two belts. In this case, by taking advantage of the structure that holds each of the bags with the two belts in a sandwiched manner, the volume of the gas to be filled into the bags is optimized. In other words, by adjusting the distance between the two belts, the volume of the gas to be filled into the formed bags can be controlled, thus making the volume of the bags to be ejected uniform. Generally with the vertical bag form-fill-seal packaging machine, the gas to be filled is sprayed into the bags at the time of bag forming. By spraying it with a little more than the required amount and making the volume of the bags uniform through the adjustment of the belt-to-belt distance, the volume of the bags to be ejected will be substantially uniform even if the pressure of the gas supply unit has changed.

A vertical bag form-fill-seal packaging machine in accordance with an eighth aspect of the present invention is the machine as defined either in the fifth, sixth, or seventh aspects, wherein the sealing is heat-sealing and the machine further includes a cooling unit for spraying a cooling gas on the sealed part of each of the bags held in a sandwiched manner by the two belts. In this case, by taking advantage of the structure that holds each of the bags in a sandwiched manner, a gas for cooling is sprayed onto the bags thus held in a sandwiched manner, to ensure the bonding strength of the heat-sealed part. With a conventional machine,

there is a high possibility that the posture of the bags to be ejected varies if a cooling gas is sprayed. However, with the two belts sandwiching the bags in the machine of the present invention, the posture will rarely be affected even when cooled by spraying a gas. In addition, the cooling strengthens the sealing, thereby reducing the problem of bag breakage that may cause the production line to stop while the bags are still being transferred.

A vertical bag form-fill-seal packaging machine in accordance with a ninth aspect of the present invention is the machine as defined in the first or second aspect, further including a second transfer unit for receiving, transferring, and ejecting the bags transferred from the first unit, and a second drive unit for driving the second transfer unit, wherein the control unit further controls the second drive unit in addition to the first drive unit.

A vertical bag form-fill-seal packaging machine in accordance with tenth aspect of the present invention is the machine as defined in the ninth aspect, wherein the transfer unit is a belt with a guide bar approximately orthogonal to the direction of transfer. In this case, the transfer unit, which is a belt, has a guide bar that prevents the bags from shifting on the bag.

A vertical bag form-fill-seal packaging machine in accordance with an eleventh aspect of the present invention is the machine as defined in any of the previous aspects, further including a memory storage unit for storing control settings for each set of products

to be packaged, wherein the control unit maintains control according to the settings stored in the memory storage unit.

A vertical bag form-fill-seal packaging machine in accordance with a twelfth aspect of the present invention is the machine as defined in the eleventh aspect, wherein at least one of the control setting items to be stored in the memory storage unit is the speed of the drive unit. In this case, by setting the drive unit speed according to the bags, it becomes possible to adjust the bag-to-bag pitch to be ejected and the bag ejection time interval to reflect the operating conditions of the equipment in the downstream process.

A vertical bag form-fill-seal packaging machine in accordance with a thirteenth aspect of the present invention is the machine as defined in the twelfth aspect, wherein the control unit provides data at least on the bag ejection time interval to the external equipment in the downstream process. In this case, because the data on the time interval between each bag's ejection are provided to the external equipment in the downstream process, an operation synchronizing with the ejection time intervals of the bags sent from the vertical bag form-fill-seal packaging machine becomes possible.

These and other objects, features, aspects and advantages of the present invention will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the attached drawings which form a part of this original disclosure:

Fig. 1 is a schematic diagrammatical view of a conventional vertical bag form-fill-seal packaging machine with devices in the upstream and downstream processes;

Fig. 2 is a schematic diagrammatical view illustrating an example of a production line for a downstream process for a bag ejected from a conventional vertical bag form-fill-seal packaging machine;

Fig. 3 is a schematic structural diagrammatical view of a conventional vertical bag form-fill-seal packaging machine;

Fig. 4 is an elevational view of a vertical bag form-fill-seal packaging machine in accordance with a first embodiment of the present invention;

Fig. 5 is a control block diagrammatical view of the vertical bag form-fill-seal packaging machine of Fig. 4;

Fig. 6 is an elevational view of the adjacent area of the forced ejector of Fig. 4;

Fig. 7 is an elevational view of the adjacent area of the forced ejector in accordance with a second embodiment of the present invention;

Fig. 8 is a rear elevational view of the adjacent area of the forced ejector of Fig.7;

Fig. 9 is an elevational view of the adjacent area of the forced ejector in a variation of the second embodiment; and

Fig. 10 is an elevational view illustrating how the belt-to-belt distance of the forced ejector is changed in another variation of the second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment Compared to the Prior Art

A conventional measuring and bag forming/packaging line is illustrated in Fig. 1, together with an example of devices in the upstream and downstream processes. In this case, a product for example, potato chips, is transferred by a supply conveyor 101 to a position above the measuring unit 110. The product, once in the measuring unit 110, is measured into a predetermined weight (or quantity) and continuously discharged downward.

The product discharged from the measuring unit 110 moves into a vertical bag form-fill-seal packaging machine 120 located under the measuring unit 110. The vertical bag form-fill-seal packaging machine 120 is a device for forming bags, and filling and packing a product in the bags simultaneously. The bags containing the product as a result of the packaging slides down the stationary chute 129 provided with the vertical bag form-fill-seal packaging machine 120, and are loaded onto the transfer conveyor 130. The transfer conveyor 130 transfers the bags continuously discharged there to a weight checker 140 in the downstream process.

If bags need to be continuously packed in carton boxes, the bags are transferred from the transfer conveyor 130 to the weight checker 140 and a sealing checker 150 as

shown in Fig. 2. The bags subjected to the weight and sealing checks here go through a directing unit 160 and a posture adjustment unit 170 so that they are sent to a boxing unit 180 in a file or files.

The boxing unit 180 is provided with a handling mechanism 181 holding the bags through suction, to pack the bags B into a carton box. The carton box in which the bags B are packed is transferred via a carton box transferring unit 190 to a box-sealing unit and a labeling unit (not shown).

Fig. 3 shows the major structure of a conventional vertical bag form-fill-seal packaging machine 120, the so-called vertical pillow packaging machine. In the vertical bag form-fill-seal packaging machine 120, sheet-like film Fm drawn from a roll of film 128 (see Fig. 1) is formed into a tubular shape through a former 121 and a tube 122 and fed downward by a pull-down belt mechanism 125. The overlapped vertical ends of the tubular film Fmc is heat-sealed by a vertical sealing mechanism 123. When the measured product fills the tubular film Fmc through the tube 122, the transverse sealing mechanism 124 provided under the tube 122 performs transverse sealing in the area that will become the top of the bag preceding and the bottom of the following bag. Concurrently with the transverse sealing, the center of the transversely sealed part is cut by a cutter built in the transverse sealing mechanism 124. The bags thus cut slide down on the stationary chute 129 provided under

the transverse sealing mechanism 124, and then transferred on a transfer conveyor 130 to the devices in the downstream processes.

Overall Structure

A vertical bag form-fill-seal packaging machine in accordance with the first embodiment of the present invention is described below.

Fig. 4 shows a vertical bag form-fill-seal packaging machine 1, including a forced ejector 6 in accordance with a first embodiment of the present invention. The vertical bag form-fill-seal packaging machine 1 is a machine for packing a product such as food for example, potato chips into bags, mainly including a bag-forming/packaging section 5, a film supply unit 4, and a forced ejector 6. The bag forming/packaging section 5 is a main region for packing the product into bags. The film supply unit 4 supplies the bag-forming/packaging section 5 with the film that ultimately becomes bags. The forced ejector 6 forcibly ejects downward the bags formed by the bag-forming/packaging section 5. An operation switch 7 (see Fig. 5) is provided at the front of the vertical bag form-fill-seal packaging machine 1. A liquid-crystal display 8 for showing the status of the operation is provided where the operator manipulating the operation switch can visually check operations. The control unit 20 shown in Fig. 5 controls the operation of each of the drive units for the

vertical bag form-fill-seal packaging machine 1 and displays various data on the liquid-crystal display 8 based on the input from the operation switch 7.

A Structure of the Film Supply Unit

Referring to Fig. 4, the film supply unit 4 supplies sheet-like film to a forming mechanism 13 in the bag-forming/packaging section 5 that is to be described later. A roll of film is set on the film supply unit 4 so that the film Fm is unreeled from the roll.

A Structure of the Bag-Forming/Packaging Section

As shown in Fig. 4, the bag-forming/packaging section 5 includes the forming mechanism 13, a pull-down belt mechanism 14, a vertical sealing mechanism 15, and a transverse sealing mechanism 17. The forming mechanism forms the film Fm that is fed in as a sheet into a tubular shape. The pull-down belt mechanism 14 transfers the tubular-shaped film (hereinafter called "tubular film Fmc") downward. The vertical sealing mechanism 15 vertically seals the overlapped part of the tubular film Fmc. The transverse sealing mechanism 17 transversely seals the tubular film Fmc to close the top and bottom of each of the bags.

As shown in Fig. 4, the forming mechanism 13 has a tube 31 and a former 32. The tube 31 is a cylindrical member with its top and bottom ends open. The tube 31 is made integral with the former 32 through a bracket. Measured items such as potato chips are put

into the open top end of the tube 31 from the measuring unit 11. The former 32 is provided in such a manner that it surrounds the tube 31. The shape of the former 32 is such that allows the sheet-like film Fm fed from the film supply unit 4 to be formed into a tubular shape when it passes between the former 32 and the tube 31. The pull-down belt mechanism 14 is a mechanism for sucking the film Fm wound on the tube 31 to pick it up and transfer it downward. The pull-down belt mechanism mainly includes a driver roller 41 and a driven roller 42, as well as a suction belt 43. The vertical sealing mechanism 15 vertically seals the overlapped part of the film Fm wound on the tube 31 by heating it while pressing it against the tube 31 at a predetermined pressure. The vertical sealing mechanism 15 has a heater and a heater belt that contacts the overlapped part of the film Fm when heated by the heater.

The transverse sealing mechanism 17 is provided beneath the forming mechanism 13, the pull-down belt mechanism 14, and the vertical sealing mechanism 15. As shown in Fig. 6, the transverse sealing mechanism 17 has a pair of symmetrical sealing jaws. The two sealing jaws 17a, each of which turns in the shape of the letter "D", leaving tracks T that are symmetrical to each other. The sealing jaws 17a mate with each other when the tubular film Fmc is ready to be transversely sealed. The transverse sealing mechanism 17 has a cutter not shown in the drawing. The cutter separates the bag from the tubular film Fmc that follows the bag at the center of the part sealed by the sealing jaws 17a. The transverse sealing

mechanism 17 crimps the part to be transversely sealed by sandwiching the tubular film Fmc between the sealing jaws 17a, a process that requires heat in addition to pressure. Therefore, in order to heat the mating surfaces of the sealing jaws 17a that contact the tubular film Fmc, a heater is provided in the each of the sealing jaws 17a, and a thermocouple is attached thereto as well.

A Structure of the Forced Ejector

The forced ejector 6 mainly includes an endless belt 61, a driver roller 62, a driven roller 63, and an AC servo motor 64. The servo motor 64 turns the driver roller 62 and provides super-fine turning control. The servo motor 64 is controlled by the control unit 20 as shown in Fig. 5. As shown in Fig. 6, the belt 61 is inclined so that the bag B moves diagonally downward. Still referring to Fig. 6, the forced ejector 6 is positioned at a height that enables the bottom of the bag B to contact with the upper side of the belt 61 when the bag B is separated by the cutter provided in the sealing jaws 17a. If the forced ejector 6 is at a position higher than this, the belt 61 will thrust the bag B upward before the transverse sealing is completed, resulting in a poor transverse sealing. Conversely, if the forced ejector 6 is located too low, the falling distance to the point where the separated bag B contacts the belt 61 becomes too long, thus causing the bag B to bounce on the belt 61 and deteriorating the stability of the posture of the bag B.

A Structure of the Control Unit

As shown in Fig. 5, the control unit 20 is connected with the film supply unit 4, bag-forming packaging sections 5, and forced ejector 6 of the vertical bag form-fill-seal packaging machine 1 to control the operation of each of the drive units. First, the control unit 20 controls the rotating speed of the sealing jaws 17a of the transverse sealing mechanism 17 as well as the traveling speed of belt 61 of the forced ejector 6 according to the downward feeding speed of the tubular film Fmc on the pull-down belt mechanism 14. In controlling the forced ejector 6, the rotating speed of the servo motor 64 is controlled according to the feeding speed of the tubular film Fmc, i.e. the bag-forming/packaging section 5 bag-forming capacity, to change the ejection speed of the bag B (the traveling speed of the belt 61) at the forced ejector 6. In this production line, an AC servo motor 131 is employed as a driving power source for the transfer conveyor 130. The servo motor 131 is controlled according to the data on the ejecting speed of the forced ejector 6 and the bag ejection time interval that are output from the control unit 20. The controlling of the servo motor 64 for the forced ejector 6 and the servo motor 131 for driving the transfer conveyor 130 may be carried out by changing the rotating speed to adjust the ejection interval between the bags B, or by performing an intermittent driving to repeat ON/OFF switching of operations to adjust the bags B' ejection interval.

Further, the control unit 20 has an external output terminal 21, which can send the data on the bags B ejecting speed and bag ejection time interval to the transfer conveyor 130 and other devices in the downstream process (the weight checker 140, the sealing checker 150, the boxing unit 180, and the like shown in Fig. 2). In the control unit 20, a memory storage unit such as a hard disc is also provided. Data on the shape, dimensions, material, volume, and the like for each set of the bags are stored in the memory storage unit, and the control patterns for each of the drive units, including the appropriate controlling pattern for the transfer speed of the forced ejector 6, are preset.

An Operation of the Vertical Bag Form-Fill-Seal Packaging Machine

An operation of the vertical bag form-fill-seal packaging machine 1 is described below.

Referring to Fig. 4, the sheet-like film Fm fed from the film supply unit 4 to the forming mechanism 13 moves through the former 32 and is wound on the tube 31. The sheet-like film Fm is shaped in a tubular form and transferred, in this condition, downward by being carried on the pull-down belt mechanism 14. When wound on the tube 31, the film Fm has both ends overlapped on its circumference. The overlapped part is to be vertically sealed by the vertical sealing mechanism 15. The tubular film Fmc, now in a cylindrical form as a result of the vertical sealing, moves out of the tube 31 and down to the transverse

sealing mechanism 17. At this point, the position of the tubular film Fmc is in the area indicated by the double-dot dash line in Fig. 4. Now, concurrently with the travel of the tubular film Fmc, a mass of items, for example, potato chips, falls from the measuring unit 110 via the tube 31. At the transverse sealing mechanism 17, the bottom and the top of the bag are transversely sealed, in sequence, with the potato chips present in the tubular film Fmc. In the process of transverse sealing by the transverse sealing mechanism 17, the cutting process by the cutter provided in the sealing jaws 17a is carried out concurrently as shown in Fig. 6. The cutter cuts the approximate center of the transversely sealed part. Thus, as seen in Fig. 4, the bag B is separated from the tubular film Fmc that follows, and contacts the upper part of the belt 61 of the forced ejector 6 and is forcibly carried diagonally downward according to the turn of the belt 61.

In this process, if the bag B contacts the belt 61 at a speed lower than the traveling speed of the belt 61, the bags B may be bridged and tip forward. If the traveling speed of the belt 61 is substantially higher than the falling speed of the bag B, the belt surface may not be able to catch the bag B. Therefore, the traveling speed of the belt 61 is set equivalent to or a little higher than the falling speed of the bag B. The maximum value of this speed setting varies with the materials of the belt 61, the film Fm, and the weight of the filled bag B.

Therefore, the control unit 20 considers these conditions in controlling the rotating speed of the servo motor 64 to adjust the traveling speed of the belt 61.

In setting a specific traveling speed for the belt 61, the distance between the transverse sealing mechanism 17 and the belt 61, the falling speed of the bag B upon separation, gravitational acceleration, and the like are used as the bases for calculation.

The vertical bag form-fill-seal packaging machine, in accordance with the first embodiment of the present invention, has the following features:

The vertical bag form-fill-seal packaging machine 1 is provided with the forced ejector 6 instead of a conventional stationary chute 129 as seen in Fig. 3. Thus, variation of the ejection pitch and the postures of the bag B ejected onto the transfer conveyor 130 is prevented. With a conventional stationary chute, on which frictional resistance is applied when the bag B slides down or the impact is caused when falling, there is a high possibility that the ejection pitch and the posture of the bag B may become uneven. By using the forced ejector 6, the belt 61 is allowed to contact with the bag B so that the bag B, together with the belt 61, can be forcibly moved through the turn of the driver roller 62, thereby preventing the variation of the pitch and the posture of the bag as shown in Fig. 4.

In the vertical bag form-fill-seal packaging machine 1, the belt 61 is provided in a slanted manner instead of vertically, to ensure that the bag B separated from the tubular film

Fmc contacts the belt 61. Also, the incline of the belt 61 is such that the bag B moves diagonally downward, thus reducing the impact that may be caused when the bag B contacts with the belt 61, as well as minimizing the change in the posture of the bag B. This also reduces the problem that the bag B may be transferred in a stand-up posture. As shown in Fig. 6, the incline of the belt 61 also contributes to a reduction in the impact that may be caused when the bag B moves from the belt 61 to the transfer conveyor 130.

Referring now to Fig. 5 in the vertical bag form-fill-seal packaging machine 1, the control unit 20 takes control of linking the bag-forming capacity of the bag-forming/packaging section 5 with the ejection (traveling) speed of the bag B by the forced ejector 6, thereby enabling the pitch and the ejection time interval of the bag B ejected by the forced ejector 6 onto the transfer conveyor 130 in the downstream process to be set to predetermined values. Even with the bag-forming capacity varied between low speed (low throughput) and high speed (high throughput), the pitch between the bags B to be ejected and the ejection time interval between the bags B can be adjusted to suit the external devices of the downstream processes such as the weight checker 140, the sealing checker 150, and the boxing unit 180 by controlling the servo motor 64 for the forced ejector 6 to change the ejecting speed of the bag B.

In the vertical bag form-fill-seal packaging machine 1 in accordance with the first embodiment of the present invention, the AC servo motor 131 is employed as a driving power source for the transfer conveyor 130, to control the transferring speed of the transfer conveyor 130 according to the ejecting speed (traveling speed) and the ejection time interval for the bag B at the forced ejector 6. Therefore, even in high-speed forming of the bag B with an improved capacity of the vertical bag form-fill-seal packaging machine 1, the transfer of the bag B from the bag-forming/packaging section 5 to the forced ejector 6 and from the forced ejector 6 to the transfer conveyor 130 become smooth by synchronizing the ejecting speed of the forced ejector 6 and the transfer conveyor 130 to aforesaid speeds, thus preventing the deterioration of the posture and the pitch of the bag B.

The control unit 20 of the vertical bag form-fill-seal packaging machine 1 controls the transfer speed of the transfer conveyor 130 according to the ejecting speed of the forced ejector 6. The control unit 20 also provides data such as the ejecting speed, the ejection time interval, ejection pitch (interval between the bag tops or the bags themselves, bag length, and the like) at the forced ejector 6 to the external equipment in the downstream process via the external output terminal 121. This enables process control at the external equipment (at a device in the downstream process) such as the weight checker 140, the sealing checker 150, and boxing unit 180 that takes advantage of aforesaid data.

For example, the external equipment that has received the data on the ejection time interval and the ejection pitch (bag-to-bag distance) sets the processing speed and the transferring speed according to the ejection time interval; if the ejection pitch is too small, the transferring speed is increased so that the bag-to-bag interval is increased. The ejecting speed can be obtained from the following formula:

(Bag length + bag-to-bag distance) / (ejection time interval).

The bag-to-bag distance can be obtained from the following formula:

(Ejecting speed) X (ejection time interval) - (bag length).

The external equipment can be controlled properly for processing with the data on (ejection time interval); (bag length); and (ejecting speed) or (bag-to-bag distance).

Some variations of the first embodiment are described below as examples.

(1) In the aforesaid embodiment, the forced ejector 6 including the belt 61, the driver roller 62, driven roller 63, and the servo motor 64 is incorporated in the vertical bag form-fill-seal packaging machine 1. The ejector may be provided as a device independent from the vertical bag form-fill-seal packaging machine. In such a case, the forced ejector 6 including the belt 61, the driver roller 62, driven roller 63, and the servo motor 64 should be provided beneath the vertical bag form-fill-seal packaging machine. In this way, the forced

ejector can be retrofitted to a conventional vertical bag form-fill-seal packaging machine after the removal of the stationary chute.

(2) In the first embodiment described so far, the forced ejector 6 includes the belt 61 that contacts the bag B and the driver roller 62 or the like that lets the belt 61 travel. It is also possible to use a mechanism for forcibly feeding the bag B without touching the bag B to make the forced ejector 6. For example, a vacuuming mechanism for sucking to draw the bag B separated by the transverse sealing mechanism 17 may be provided below the transverse sealing mechanism 17. It is also possible to provide a mechanism for generating an air flow around the bag B to be separated.

(3) In the aforesaid first embodiment, the transferring speed of the transfer conveyor 130 is linked with the vertical bag form-fill-seal packaging machine 1 by utilizing the external output terminal 21 of the control unit 20. The transfer conveyor 130 may also be incorporated into the vertical bag form-fill-seal packaging machine 1 for the purpose of controlling the transferring speed and ejection time interval in the same manner of handling as do the bag-forming/packaging section 5 and the forced ejector 6.

(4) On the belt 61 and the belt for the transfer conveyor 130 of the aforesaid first embodiment, a guide bar may be provided so that only one of the bags B fits in each space created by the guide bar. By providing such a guide bar at an appropriate interval on the belt,

the uniformity of the ejection interval between the bags B increases. It is preferable to provide the guide bar so that it is orthogonal to the direction of the belt transfer, to prevent the positional shifting of the bag B on the belt.

(5) As the belt 61 and the belt for the transfer conveyor 130 of the aforesaid first embodiment, a plurality of round belts or a vacuum suction belt also may be employed.

SECOND EMBODIMENT

Referring mainly to Fig. 7, vertical bag form-fill-seal packaging machine, in accordance with a second embodiment of the present invention, is a machine for packing a product such as food (potato chips in this case) into bags. The machine mainly includes a bag-forming/packaging section, film supply unit, a forced ejector 206, and a cooling section 9. The structure of the film supply unit and the bag-forming/packaging section are the same as those in the first embodiment. The bag-forming/packaging section is a main region for packing the product into bags, a film supply unit 4 supplies the bag-forming/packaging section with the film that ultimately becomes bags. The forced ejector 206 forcibly ejects downward the bags formed by the bag-forming/packaging section. The cooling section 9 forcibly cools the bags formed by the bag-forming/packaging section. An operation switch, a liquid-crystal display, and a control unit are also provided in the same manner as in the first embodiment of the present invention.

Structure of the Forced Ejector

As shown in Fig. 7, the forced ejector 206 mainly includes endless belts 261a &261b, driver rollers 262a & 262b, driven rollers 263a & 263b, and an AC servo motor. The servo motor for turning the driver rollers 262a & 262b is a motor capable of providing extremely fine turning control, and is controlled by the control unit (not shown). The belt 261a is placed on one driver roller 262a and three driven rollers 263a so that it travels in a manner to move the bag B downward according to the rotation of the driver roller 262a. The belt 261b is placed on one driver roller 262b and three driven rollers 263b so that it travels in a manner to move the bag B downward according to the rotation of the driver roller 262b.

As shown in Fig. 8, the belt 261b is provided with openings 269 at a uniform interval to prevent its interference with the sealing jaws 17a. Also, the driver roller 262b and the driven rollers 263b are provided so that they are placed underneath the both ends of the belts 261b to prevent their interference with the sealing jaws 17a as seen in Fig. 7. The belt 261a is similarly constructed. As seen in Fig. 7, the belt 261b extends downward farther than the belt 261a, to assist in the loading of the bag B onto the transfer conveyor 130.

A part of the transfer passage formed between the belts 261a & 261b may be inclined between the vertical area and the horizontal area so that the direction for transferring the bag B changes from vertical to horizontal as the bag moves through the passage. The

rotation of the driver rollers 262a & 262b is controlled so that the belts 261a &261b travel at a constant speed.

Structure of the Cooling Section

The cooling section 9, which includes two air sprayers 9a, is provided inside the loops of the endless belts 261a & 261b to spray air through the opening in the belts 261a & 261b to the bag B that is fed downward by the belts 261a & 261b. The ON/OFF switching and the spraying volume of the air sprayers 9a are maintained by the control unit.

Operation of the Vertical Bag Form-Fill-Seal Packaging Machine

An operation of the vertical bag form-fill-seal packaging machine in accordance with the second embodiment is described below.

As with the first embodiment, the sheet-like film fed from the film supply unit to the forming mechanism moves through the former and is wound on tube. The sheet-like film is shaped in a tubular form and transferred, in this condition, downward by being carried on the pull-down belt mechanism. When wound on the tube, the film has both ends overlapped on its circumference, and the overlapped part is to be vertically sealed by the vertical sealing mechanism.

The tubular film Fmc, now in a cylindrical form as a result of the vertical sealing, moves out of the tube and down to the transverse sealing mechanism. At this point,

concurrently with the travel of the tubular film Fmc, a mass of items, for example potato chips falls from the measuring unit via the tube. Now, through the transverse sealing mechanism, the bottom and the top of the bag are transversely sealed in sequence, with the items, for example potato chips present in the tubular film Fmc.

As seen in Fig. 7, in the process of transverse sealing by the transverse sealing mechanism 17, the cutting process by the cutter provided in the sealing jaws 17a is carried out concurrently. The cutter cuts the approximate center of the transversely sealed part. Also, prior to the process of transverse sealing, the bag B (yet to be transversely sealed) is held by the belts 261a & 261b that come into contact with the bag on both sides, and forcibly fed downward. The feeding speed is controlled by the control unit to be synchronous with the feeding speed on the pull-down belt mechanism and the traveling speed of the sealing jaws 17a.

The bag B that has moved out of the transverse sealing mechanism 17 is subjected to the air sprayed from the cooling section 9 while it is held by the belts 261a & 261b of the forced ejector 206 in a sandwiched manner and being transferred downward. This cools the heat-sealed part, thus increasing its bonding strength before the bag B is loaded on the transfer conveyor 130.

As shown in Fig. 7, the bag B that has moved out of the cooling section 9 leaves the belts 261a & 261b and is loaded on the transfer conveyor 130 and carried thereon to devices such as the weight checker in a downstream process.

The vertical bag form-fill-seal packaging machine in accordance with the second embodiment, of the present invention has the following features:

By turning the belts 261a & 261b through the driver rollers 262a & 262b to move the bag B downward while holding the bag B with the two belts 261a & 261b of the forced ejector 206 in a sandwiched manner, the bag B is forcibly moved to the transfer conveyor 130 in the second embodiment. Thus, by holding the bag B with the two belts 261a & 261b in a sandwiched manner, problems such as slippage of the belts 261a & 261b resulting in a variation of the pitch of the bags B to be ejected can be reduced.

Taking advantage of the structure for holding bag B with the two belts 261a & 261b in a sandwiched manner, cooling air is sprayed upon bag B thus held to ensure the bonding strength of the heat-sealed part of the formed bag B.

In a conventional machine, the sealed part (particularly the transversely sealed part) of the bag B may be sent to the device in a downstream process without sufficiently being cooled down, or air is blown on the bag B on a transfer conveyor with a cooling fan. However, in blowing wind upon the bag B on the transfer conveyor, there is a need to restrict

the air volume so that the position of the bag B will not be shifted, which makes it difficult to achieve a sufficient cooling effect in a high-speed operation.

To counter this problem, the second embodiment achieves a condition in which the posture hardly will be affected, even with air-spray cooling, through the method of holding the bag B with the two belts 261a & 261b in a sandwiched manner. It employs a structure in which air is sprayed with the air sprayer 9a to the bag held by the belts 261a & 261b in a sandwiched manner. This allows effective cooling of the heat-sealed part of the formed bag B, thus reducing bag breakage even with high-speed ejection of the bag B.

Some variations of the second embodiment are described below as examples.

(1) In the aforesaid second embodiment, the bag B that has left the belts 261a & 261b moves almost vertically until it hits against the transfer conveyor 130 as shown in Fig. 7. In a high-speed operation, the impact caused when the bag B comes up against the transfer conveyor 130 may be great. To reduce the impact, a forced ejector 306 as shown in Fig. 9 may be employed instead of the forced ejector 206.

The forced ejector 306 shown in Fig. 9 includes endless belts 361a & 361b, driver rollers 362a & 362b, driven rollers 363a & 363b, a direction-changing driven roller 364, and an AC servo motor. The servo motor for turning the driver rollers 362a & 362b provides extremely fine turning control, and is controlled by a control unit. The belt 361a is placed on

one driver roller 362a and three driven rollers 363a so that it travels in a manner to move the bag B downward according to the rotation of the driver roller 362a. The belt 361b is placed on one driver roller 362b, three driven rollers 363b, and the direction-changing driven roller 364 so that it travels in a manner to move the bag B downward according to the rotation of the driver roller 362b.

The belts 361a & 361b are provided with openings at a uniform interval to prevent its interference with the sealing jaws 17a. The driver rollers 362a & 362b, the driven rollers 363a & 363b, and the direction-changing driven roller 364 are provided so that they come under the both ends of the belts 361a & 361b to prevent their interference with the sealing jaws 17a. The rollers 362a, 362b, 363a, 363b, & 364 are provided in the positions shown in Fig. 9, so that the bag B, after leaving the cooling section 9, moves in a different direction, changing from vertical to horizontal, toward the transfer conveyor 130. The rotation of the driver rollers 362a & 362b is controlled so that the belts 361a & 361b travel at a constant speed. Thus, the structure of the forced ejector 306 in the second embodiment is made to allow, in its lower portion, the bag B to move toward the horizontal direction; i.e. the surface on which the bag B below the belt 361b comes into contact is inclined so that the bag is ejected horizontally onto the transfer conveyor 130. This significantly reduces the impact that may be caused when the bag B is loaded onto the transfer conveyor 130

(2) Referring to Fig. 7, the forced ejector 206 in the second embodiment may further be provided with a function to optimize the volume of the gas to be filled in the bag B. In such a case, the distance between the belts 261a & 261b of the forced ejector 206 is made variable by a means for changing the belt-to-belt distance. The distance between the belts 261a & 261b is also controlled by the control unit 20 according to the type of the bag B and the volume of the gas required to fill the bag.

A possible example of the means for changing the belt-to-belt distance is a mechanism that moves a first unit having the belt 261a, the driver roller 262a, and the driven roller 263a, and a second unit havinf the belt 261b, the driver roller 262b, and the driven roller 263b to the right or left by using motorized ball screws and a servo motor. As shown in Fig. 10, this makes it possible to shift each element of the forced ejector 206 from the position shown with the solid line to the position shown with the broken line, and to change the distance between the belts 261a &261b into any value with the control unit. Then, by adjusting the distance between the belts 261a & 261b while setting the volume of the gas to be filled which is sprayed from above the tubular film Fmc somewhat higher, the volume of the gas to be filled in the bag B, or the volume of the bag B, is made uniform.

In a conventional machine, the volume of the gas to be filled is adjusted by varying the period of the spraying time, for example. However, if the gas supply sources are

centralized in a large-scale plant, the supply pressure of the gas supply source often varies, thus making it difficult to prevent variation in the volume of gas to be filled. A variation in the volume of gas to be filled results in a variation in the volume of the bag B, leading to a problem at the boxing unit in a downstream process. The boxing unit packs a specified number of the bags B into carton boxes by the use of a handling mechanism that utilizes suction or the like. If the volume of the bag B is not constant as described above, the following problems may occur: mishandling, bag breakage, a gap in the carton box after the specified number of the bags B are placed inside. Thus problems during transportation, and a failure to pack the specified number of the bags B in the carton box may result.

To counter the above, this variation of the second embodiment, by taking advantage of structures for holding the bag B with the two belts 261a & 261b in a sandwiched manner and by adjusting the distance between the two belts 261a & 261b, enables the controlling of the volume of the gas to be filled in the formed bag B, thus achieving uniformity of the volume of the bag B. This allows the bag B, almost uniform in volume, to be supplied to the devices in a downstream process, which should reduce the incidence of problems in the devices during the downstream process.

The terms of degree such as "substantially", "about" and "approximately" as used herein mean a reasonable amount of deviation of the modified term such that the end result is

not significantly changed. These terms should be construed as including a deviation of at least ± 5% of the modified term if this deviation would not negate the meaning of the word it modifies.

While only selected embodiments have been chosen to illustrate the present invention, it will be apparent to those skilled in the art from this disclosure that various changes and modifications can be made herein without departing from the scope of the invention as defined in the appended claims. Furthermore, the foregoing description of the embodiments according to the present invention are provided for illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.